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EDITOR'S PAGE

ESTONIAN OIL SHALE RETORTING INDUSTRY AT THE CROSSROADS

Estonian "kukersite" oil shale is an excellent fossil fuel for producing oil, gaseous fuel and chemicals. The Fischer Assay oil yield from this rock is 65–68% on kerogen basis. The oil is rich in oxygen-containing compounds, especially in phenols and ketones. Characteristically, "kukersite" oil phenols are predominantly of the resorcinol series. Despite all of these riches, the oil-shale-processing industry in Estonia is facing some difficult choices.

The first challenge will be to select retorting technology to extract oil from raw oil shale. In reality, there are three possible technologies:

(1) processing in gravitational shaft retorts (so-called 'gas generators'), otherwise known as the *Kiviter* process
(2) the SHC process, otherwise known as the *Galoter* process
(3) the *Alberta Taciuk* process (ATP)

Each of these has its own benefits and drawbacks.

The *Kiviter* process accepts only large-particle feed. As the heat carrier the process gas combustion products are used. The yield of crude oil is in the range of 14–17% on raw shale basis. The oil contains only a small amount of low-boiling fractions. Solid residue (semicoke) contains 4–6% organic carbon. This causes environmental concern, as spent shale piles continue to leach toxic substances. Another drawback of this process is a large quantity of process water. The majority of oil-shale-originated resorcinol-series phenols end up in this water. Further processing of the water to extract phenols and decompose other toxic compounds is expensive. However, to date, the *Kiviter* process has proved to be the only method that actually works – reliably and consistently.

The *Galoter* process uses a rotary kiln-type retort. As the heat carrier solid shale ash is used. The process can accept shale fines. The oil yield varies, averaging approximately 12% on raw shale basis. The oil contains 15–20% low-boiling fractions. The process produces only small amounts of phenol-contaminated water at low concentrations. Further processing of the water is inexpensive. Most of the phenolic compounds generated in the retorting process remain in the oil and may be easily removed by water extraction. Carbon is burned out from spent shale in a special furnace. However, even the burning residue, so-called black ash, causes environmental concerns, as it contains some organic carbon and decomposable calcium sulphide.

The *Alberta Taciuk* process also uses a rotary kiln-type retort and accepts shale fines. A combined retort-heating system is used: internal heating with shale ash and external heating with combustion gases generated from burning carbon available in semicoke. The oil contains up to 30% low-boiling fractions. The process produces only small amounts of contaminated water with low concentration of phenols. When retorting Estonian oil shale, the ATP has been tested only in small-scale trials and the results are preliminary. Any deficiencies will become evident only during industrial-scale production.

The second challenge will be to decide what commercial products will be made from the raw shale oil and how. The selection depends on how the oil was produced. SHC and *Alberta Taciuk* processes produce oil rich in low-boiling fractions. These oils should be first upgraded by treating with hydrogen to remove sulphur, nitrogen and oxygen and to saturate the unsaturated hydrocarbons. If upgrading is not used, it is difficult to find a commercial market for fractions boiling below 200 °C. Upgraded oil, a so-called light sweet crude, can be further processed like any crude petroleum. In this case, the main products are gasoline, kerosene and gas oils. If there is a market for chemicals produced from phenols, the phenols can be removed from oil by water extraction before upgrading. This process sequence is markedly different from the present state of operations and excludes all specialty products characteristic for oil shale.

If the raw shale oil is produced by the *Kiviter* process, it is possible to process it in several ways. It is possible to proceed as described above for SHC and ATP oils. It is also possible to enhance the feasibility of current technology by finding new specialty markets for oil constituents and phenolic compounds or by developing new specialty products. Not all possibilities have been explored as yet. For example, in addition to their known uses, distillate oils from the *Kiviter* process can also be used as diluents for petroleum-originated heavy oils and as tack enhancing additives for bituminous materials.

The need to decide the future path for the oil-shale-processing industry has been debated for a while now. Unfortunately, choices have not been made. The longer the industry waits, the more difficult it will be to deal with this issue in the future.

With time, current technology will become obsolete. With outdated technology, the industry will not be able to maintain the competitive edge needed to produce oil and specialty chemicals from oil shale in the marketplace. The competitiveness of oil shale as a resource for oil and specialty chemicals is fading along with the aging technology.

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